Aerial surveys of geese, swans and shorebirds at Mills Lake, NWT during the spring and fall migration period: 1994-1997

Paul Latour

Canadian Wildlife Service
Environmental Conservation Branch

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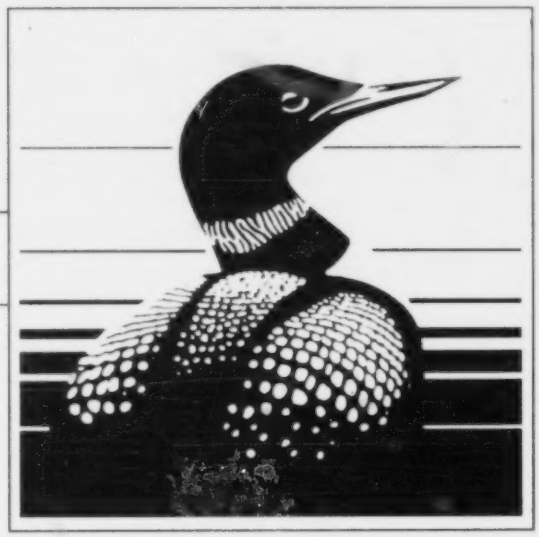

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EXECUTIVE SUMMARY

Aerial surveys of waterfowl and shorebirds were conducted at Mills Lake, NWT during the spring and fall migration periods from 1994 to 1997. The primary objective of the surveys was to determine the abundance of Lesser Snow Geese (*Chen caerulescens caerulescens*), 'Dark' Geese (Greater White-fronted Geese, *Anser albifrons*; Shortgrass Prairie Population of Canada Geese, *Branta canadensis hutchinsii* and *parvipes*) and Tundra Swans (*Cygnus columbianus*) staging at Mills Lake during the spring and fall migration. A secondary objective was to determine the use of Mills Lake by shorebirds at those times.

Water levels at Mills Lake varied considerably among the years, and this in turn greatly affected the numbers of staging waterfowl. In 1994 and 1995, both spring and fall water levels were much lower than in 1996 and 1997. This meant that in the earlier years there was greater food availability for geese and swans resulting in greater numbers staging at Mills Lake. In the springs of 1994 and 1995, there was a maximum of 11,710 and 47,000 Lesser Snow Geese, 4,673 and 3,000 Dark Geese, and 1,535 and 6,000 Tundra Swans at Mills Lake. In the fall, there was a maximum of 7,400 and 2,030 Lesser Snow Geese, 10,722 and 3,964 Dark Geese and 10,070 and 6,754 Tundra Swans.

In 1996 and 1997, when the wetlands were flooded only small numbers (< 600) of Lesser Snow Geese were observed at Mills Lake in the spring and fall during each survey flown. Dark Geese were also few in numbers (< 700) in each spring survey. However, in the fall surveys when water levels were also high, several thousand Dark Geese were observed on each of several surveys (maximum of 5,409). It would appear, therefore that Dark Geese were not as sensitive to the high water levels as Snow Geese even though both are attracted to Mills Lake because of the extensive sedge (*Carex*

spp.) stands there. Tundra Swans were also far fewer in numbers in the high water years of 1996 and 1997 with a maximum of 693 and 39 in the spring and virtually none in the fall surveys.

The numbers of staging shorebirds in 1996 and 1997 were low compared to what would be expected in a wetland the size of Mills Lake. This may have been related to the lack of exposed mudflats and shoreline in the spring and fall of those years.

Mills Lake was identified by the Canadian Wildlife Service as a Terrestrial Key Habitat site (Alexander et al., 1991). Based on the survey data from this study, Mills Lake continues to meet this classification based on the criterion of 1% of the national population of a migratory bird species known to use a specific site at some point during the year. The average daily counts for Lesser Snow Geese, Dark Geese (if it is assumed the large majority of these were Greater White-fronted Geese) and Tundra Swans were >2% of the estimated national populations for these species. It is because of its recognized importance by both management agencies as well as local Aboriginal communities that Mills Lake has been included as part of a large candidate protected area scheduled for possible designation in 2007.

RÉSUMÉ

Des relevés aériens de sauvagine et d'oiseaux de rivage ont été réalisés au lac Mills (T. N.-O.) durant les migrations printanières et automnales de 1994 à 1997. Ces relevés avaient pour principal objectif de déterminer l'abondance des Petites Oies des neiges (*Chen caerulescens caerulescens*), des oies « foncées » (Oies rieuses, *Anser albifrons*, et population de Bernaches du Canada des prairies de graminées basses, *Branta canadensis hutchinsii* et *B. c. parvipes*) et des Cygnes siffleurs (*Cygnus columbianus*) qui font halte au lac Mills durant les migrations printanière et automnale. Ces relevés visaient aussi à déterminer l'utilisation du lac Mills par les oiseaux de rivage dans ces périodes.

Le niveau du lac Mills a varié considérablement durant les quatre années, ce qui a eu un effet très marqué sur les effectifs d'oies. En 1994 et 1995, le niveau de l'eau tant au printemps qu'à l'automne a été beaucoup plus bas qu'en 1996 et 1997. Il y avait donc dans les deux premières années plus de nourriture disponible pour les Petites Oies des neiges et les Cygnes siffleurs, qui ont ainsi alors été plus abondants. Aux printemps de 1994 et 1995, on a dénombré respectivement des maximums de 11,710 et 47,000 Petites Oies des neiges, 4,673 et 3,000 oies foncées et 1 ,535 et 6,000 Cygnes siffleurs au lac Mills. Aux automnes, les maximums ont été respectivement de 7,400 et 2,030 Petites Oies des neiges, 10,722 et 3,964 oies foncées et 10,070 et 6,754 Cygnes siffleurs.

En 1996 et 1997, années où les milieux humides étaient inondés, on a observé à chaque relevé de faibles effectifs (< 600) de Petites Oies des neiges tant à l'automne qu'au printemps. Les oies foncées étaient aussi peu nombreuses (< 700) à chaque relevé printanier. Cependant, à chacun des relevés automnaux, alors que le niveau d'eau était également élevé, plusieurs milliers d'oies foncées ont été observées (maximum de 5,409 oiseaux). Il semble donc que les oies foncées n'ont pas été aussi sensibles que les Petites Oies des neiges au niveau élevé de l'eau, ces oiseaux étant pourtant tous

attirés au lac Mills par ses vastes peuplements de carex (*Carex* spp.). Enfin, les Cygnes siffleurs étaient aussi beaucoup moins nombreux dans les années de hautes eaux 1996 et 1997, avec des maximums de respectivement 693 et 39 oiseaux au printemps et une absence presque totale à l'automne.

Les oiseaux de rivage qui ont fait escale en 1996 et 1997 étaient peu nombreux pour un milieu humide de la taille du lac Mills. Cela pourrait s'expliquer par la faible étendue de vasière et de rive exposées au printemps et à l'automne dans ces années.

En 1991, le Service canadien de la faune a établi que le lac Mills offrait un habitat terrestre essentiel pour les oiseaux migrateurs (Alexander *et al.*, 1991). Les données de recensement de la présente étude viennent confirmer ce classement, lequel est accordé aux sites qui, à un moment ou l'autre de l'année, sont utilisés par au moins 1 % de l'effectif national d'une espèce d'oiseau migrateur. Les dénombrements quotidiens moyens de Petites Oies des neiges, d'Oies rieuses (si on suppose que cette espèce constituait la vaste majorité des oies foncées) et de Cygnes siffleurs correspondaient à > 2 % des effectifs nationaux estimés de ces espèces. Comme son importance est reconnue tant par les organismes de gestion que par les collectivités autochtones locales, le lac Mills a été inclus dans un vaste territoire candidat au statut de zone protégée, dont la désignation possible est prévue pour 2007.

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1.0 INTRODUCTION

The Mills Lake wetland has long been recognized as a regionally important habitat for migratory waterfowl and waterbirds and the Canadian Wildlife Service (CWS) raised the possibility of creating a bird sanctuary there 50 years ago (Soper 1952; Fuller 1953). The relative importance of Mills Lake to birds using the Mackenzie Valley migration corridor became apparent in the 1970's when extensive aerial surveys were conducted over wetlands along the length of the Valley in anticipation of possible pipeline construction (Salter 1974; Salter et al., 1974). Mills Lake is the only major staging wetland between sites in northern Alberta (e.g., Hay-Zama) and sites well up the Mackenzie Valley (e.g., Brackett Lake, Mackenzie Delta) and, depending on water levels, provides an important feeding area between those locations.

Mills Lake is an important traditional hunting and fishing site for the Dene of Fort Providence. Mills Lake was proposed by the International Biological Program as a site of "exceptional interest" because of its "extensive marshland which is important for its aquatic vegetation and related waterfowl use" (Beckel, 1975). The United States Fish and Wildlife Service (USFWS) and CWS have a long-standing interest in Mills Lake and view Mills Lake as an important site in the continental management system for waterfowl. For approximately the last 25 years the USFWS has operated a duck banding station there, and in a typical year bands around 2,000 ducks, primarily Mallards (*Anas platyrynchos*) and Pintails (*Anas acuta*). Ducks banded at Mills Lake have been shot by hunters in a large number of states, particularly in California and the lower Mississippi Valley (J. Hines, pers. comm.). CWS has listed Mills Lake as a "key habitat site" for migratory birds in northern Canada based on 8% of the western mid-continent population of Greater White-fronted Geese (*Anser albifrons*) and 2% of the Tundra Swans (*Cygnus columbianus*) in Canada (Alexander et al., 1991).

Since the surveys in 1972-73 (Salter 1974; Salter et al. 1974), continental populations of Lesser Snow Geese and Tundra Swans have undergone dramatic increases in numbers (Kerbes et al., 1999; Canadian Wildlife Service, 2002). In addition, in the early 1990's the Mackenzie River basin began seeing unprecedented changes, primarily in the form of resource extraction (i.e., timber, oil/natural gas) . These activities have the potential to affect the lower Mackenzie Basin, including Great Slave Lake and the Mackenzie River. Consequently, CWS wished to obtain a more recent assessment of the importance of Mills Lake as a staging wetland. The primary objective of this study carried out in 1994-1997, therefore, was to determine the abundance of the Lesser Snow Goose, Dark Geese (Greater White-fronted Goose, *Anser albifrons*; Shortgrass Prairie Population of Canada Goose, *Branta canadensis hutchinsii* and *parvipes*), Tundra Swan and Sandhill Crane (*Grus canadensis*) during the spring and fall migration. A secondary objective was to determine the use of Mills Lake by shorebirds during the spring and fall migration.

2.0 STUDY AREA

Mills Lake (approx. $61^0 30'$, $117^0 00'$) is a 393 km^2 widening of the Mackenzie River 50 km downstream from Great Slave Lake (Figure 1). The surrounding area is a low, flat lacustrine-alluvial plain which forms part of the Hay River Lowland Ecoregion, Taiga Plain Ecozone (Agriculture Canada, 1995). Extremely active fluvial processes associated with the seasonally and annually variable water levels of the Mackenzie River have resulted in successionally immature vegetation subject to frequent change (Trottier and Kemper, 1974). The northern half of the basin consists of a gradation from a band of continuous willow (*Salix bebbiana* and *Salix discolor*) beginning at the edge of the spruce (*Picea glauca*) dominated forest, to a transition zone of northern reed grass (*Calamagrostis inexpansa*) and awned sedge (*Carex atherodes*) to a wetland consisting entirely of awned sedge. The eastern section of the basin, flanked on the east by the Horn River, consists primarily of the sedge and northern reed grass zone and grading into extensive pure sedge stands. The western side of Mills Lake is a gravelly shore with a narrow marsh that disappears at the

Mackenzie River. The extensive sedge stands are subject to annual flooding and in years where water levels remain high into the growing season extensive growth of water milfoil (*Myriophyllum* spp.) and mare's tail (*Hippurus vulgaris*) can develop. In addition, stands of bullrush (*Scirpus* spp.) develop around the edge of the open water. The shallow, open water sections in the middle and southern parts of the basin contain extensive stands of submergent vegetation including pondweed (*Potamogeton* spp.) and smartweed (*Polygonum* spp.)

There appears to have been an overall decrease in water levels in the Mills Lake basin during the last several decades. In response, there has been encroachment of the shrub community and deciduous forest out into the wetland. Maps of the area (circa 1930) and later maps (circa 1950) document this encroachment. Air photos of Mills Lake taken in the late 1940's and again in the 1970's further substantiate this. (T. Chowns, pers. comm.).

3.0 METHODS

3.1 Geese and Tundra Swans

Lesser Snow Geese, Dark Geese and to a lesser extent Tundra Swans occurred in flocks around around Mills Lake. In addition, flocks tended to flush as far as 3 km ahead of the survey aircraft. Therefore, total count aerial surveys (Norton-Griffiths 1978) spaced at intervals of 4-7 days were used to estimate their numbers during the spring and fall migration periods in 1994-1997. 'Dark' Geese included both White-fronted and Canada Geese because of the difficulty in consistently distinguishing between these two species during aerial counts, particularly when they are in large flying flocks at some distance from the aircraft. Each count was done from a Cessna 185 aircraft flown at 50 m above ground and 130-145 km/hr. The author sat in the right, front seat and recorded all observations of geese and swans on both sides of the aircraft into a tape recorder. On most flights a second observer also sat in the left, rear seat and communicated any additional observations to the main observer for recording. It was not possible to correct observer bias for these surveys and group sizes were estimated. Flocks of <100 birds were

estimated to the nearest bird. Flocks between 100 and 1,000 birds were estimated to the nearest 100 birds. Flocks >1,000 birds were estimated to the nearest 500 birds. Surveys were usually flown between 1000 - 1200 hrs except on days when fog in the morning prevented flying to Mills Lake until mid-day

Each survey flight followed the same pattern (Figure 1), commencing at the mouth of the Horn River, proceeding westwards along the shoreline of the Mackenzie River for 6 km, turning north and eastwards into Mills Lake and following a meandering course over the wetlands between the standing water and the shrub zone around the northern half of Mills Lake. Birds were counted along the north shore of the Mackenzie River to a point 12 km downstream from Mills Lake. The flight path then crossed the river and proceeded eastwards along the south shore of the Mackenzie River to the mouth of The Big Snye (Figure 1). Tundra Swans occurred over the open water areas only and when present in large numbers were spread quite evenly across the lake. Therefore, swans were counted by flying 2-3 transects back and forth across Mills Lake and a tally kept out one side of the aircraft only.

3.2 Shorebirds

Shorebird surveys were conducted in an Aviat Husky aircraft flown at 30-50 m above ground and 40-50 knots airspeed. The entire edge of Mills Lake was surveyed from the mouth of the Horn River around to the point approximately 8 km downstream from Mills Lake. The south shoreline of the Mackenzie River immediately south of the above point to the mouth of the Big Snye was also surveyed. The observation area was restricted to the water edge except over areas where the edge was indistinct, such as flooded sedge stands. In these areas, the shallowest areas were searched or where no more standing water was visible. Since it is difficult to identify shorebirds to species from an aircraft, all observations were classified as small (e.g., Semipalmated Sandpiper (*Calidris pusilla*)), medium (e.g., Pectoral Sandpiper (*Calidris* melanotos)) or large (e.g., Black-bellied Plover (*Pluvialis squatarola*)). Shorebirds were surveyed during late May - early June, which corresponds to their peak migration period in the Mackenzie Valley.

4.0 RESULTS AND DISCUSSION

4.1 Survey conditions

Over the three years (1994-1997) in which surveys were conducted at Mills Lake, weather conditions varied considerably from clear to heavy overcast and calm to strong winds. Horizontal visibility, however, was always greater than 10 km. Observability error, therefore, although unknown was likely consistent for the highly visible and usually flying flocks of geese, and for swans which were distributed across the open water of Mills Lake. Spring surveys were initiated in late April when Mills Lake was still largely ice covered but local reports indicated migratory waterfowl were beginning to arrive in numbers in the Fort Providence area. Typically a band of open water appeared around the periphery of the lake around 7 May and this gradually increased in size until the ice went out in the Mackenzie River around 15 May. Once this occurred and with the associated high water levels, all remaining ice quickly flushed out of Mills Lake. Fall surveys were initiated in late August when the first flocks of Dark Geese typically arrive at Mills Lake. Surveys continued until the last Tundra Swans had departed.

The single greatest variable influencing these surveys appeared to be water levels of the Mackenzie River and their direct influence on Mills Lake. In 1994 and 1995, water levels in the spring and fall were relatively low meaning that the preferred feeding areas (sedge wetland, adjacent mudflats and submergent vegetation) were available to geese and swans during both migration periods. In 1996 and 1997, the Mackenzie River experienced higher than average water levels meaning that in the springs there was extensive flooding well into the surrounding forest. High water levels persisted through the migration period, the summer and into the fall meaning that almost all of the preferred feeding areas were unavailable during the spring and fall migration.

4.2 Lesser Snow Geese

4.2.1 Spring migration

In 1994, Lesser Snow Geese were first observed at Mills Lake on 3 May when 11,710 were observed. Peak numbers of Snow Geese were observed on 6 May (26,000). Numbers of Snow Geese declined dramatically up to 10 May (Table 1) and by 17 May only 675 Snow Geese were at Mills Lake. Snow Geese were typically concentrated in the sedge wetlands around the eastern and northern edges of the lake.

In 1995, 17,000 Snow Geese were present at Mills Lake on 7 and 9 May and this increased to 47,450 on 12 May. Two days later there were only 10,000 Snow Geese there and this declined further through to 21 May when the last survey was flown (Table 1). As in 1994, Snow Geese were concentrated around the eastern and northern periphery of Mills Lake (Figure 2). The low water level in 1995 meant that more of the extensive sedge wetlands were available to geese in 1995 than in 1994. Consequently, geese may have been stopping over longer and building-up in greater numbers than in 1994.

In 1996, the spring migration of waterfowl was delayed because of unseasonably cool temperatures. The first, and apparently only, major northward movement of migrating geese (primarily Snow Geese) was observed during 11-12 May. On 14 May, Mills Lake was almost entirely ice-free except for scattered ice pans around its connection with the main channel of the Mackenzie River. Flooding extended back into the trees around the eastern, northern and western sides of Mills Lake. The dense sedge-grass stands around the eastern and northern sides of Mills Lake were completely submerged. A second survey was flown on 21 May and the water level had receded approximately 0.5 km back from dense willows around the north side of Mills Lake. All of the sedge stands remained submerged

in an estimated 0.5-1.0 m of water. This condition persisted through May. No Snow Geese were observed on either survey. This compares with minimum daily survey counts of several thousand Snow Geese on Mills Lake during the same period in 1994 and 1995 (Table 2). The extremely high water levels at Mills Lake resulted in the dense sedge stands and beds of aquatic plants that normally provide abundant food for geese being largely unavailable to them in 1996. This, coupled with the late spring which resulted in a temporally concentrated migration of waterfowl, were likely the reasons why comparatively few migrating Snow Geese staged at Mills Lake in the spring of 1996.

In 1997, Mills Lake was still 50% ice covered on 10 May. There was a 300-400 m wide strip of open water around the edge of Mills Lake except along the west side where ice had been pushed into the willows that fringe the shoreline. The main Mackenzie River was 30-40% ice covered and this was moving freely. Mills Lake was flooded well into the willows on the east and northeast sides and into the forest on the northern and western sides. A second survey was flown on 14 May when Mills Lake was 90% ice-free. Flooding extended farther back into the willows and trees, particulary around the west side of Mills Lake. The main Mackenzie River downstream from Mills Lake was ice-jammed. Snow Goose counts were low during the two surveys. Only several hundred were observed at Mills Lake on 10 May and on 14 May only 50 were observed. Considering the high water level at Mills Lake and the relatively low numbers of birds, surveys were discontinued. The Great Slave Lake water level which has a direct bearing on the water level of the Mackenzie River, and consequently Mills Lake, was 156.73 m above sea level on 1 May 1997. For comparison, the average level for 1 May during the last 30 years was 156.67 m and the maximum level was 156.94 m. As in 1996, the extremely high water levels in 1997 resulted in Mills Lake once again offering virtually no feeding habitat for migrating geese and swans. The sedge beds along the eastern and northern sides that provide food for geese lay under 1 m of water when much of the spring flight occurred in 1997.

4.2.2 Fall migration

In 1994, the water edge was 1 km back from the first shrubbery and a 400 m wide mudflat extended around the northeast, north and northwest sides of Mills Lake. The open water of Mills Lake had large amounts of aquatic vegetation matted on the surface. The main channel of the Mackenzie River was readily discernible from the aircraft. Biologists of the USFWS banding ducks in the area reported that water levels at Mills Lake were "near record low" (J. Solberg, pers. comm.). Snow Geese arrived at Mills Lake around 10 September and the maximum number (7,400) was observed on 26 September.

In 1995, fall water levels were once again extremely low during the entire survey period. The entire Mills Lake basin and surrounding wetlands were completely dry and the Mackenzie River formed a straight shoreline past the south end of Mills Lake. As in 1994, the first Snow Geese appeared during the second week of September and the maximum number (2,030) was observed on 25 September. A few Snow Geese were observed on Mills Lake as late as 16 October. Fewer Snow Geese used Mills Lake in fall 1995 compared to fall 1994. Either fewer birds passed through the Mills Lake area in 1995 or, more likely, there was reduced feeding habitat available because Mills Lake and the surrounding wet sedge meadows were entirely dry due to low water levels in the Mackenzie River. In 1996, four flights were made to Mills Lake during 20 September-03 October. Water levels were similar to late August during the shorebird surveys. Compared to fall in 1994 and 1995, numbers of staging Snow Geese were greatly reduced. Maximum numbers were observed on 16 September when 580 were observed (Table 1). This contrasts with the several thousand observed on average each survey through the last half of September in the previous two years (Table 2). As in the spring, it is likely that the extremely high water levels greatly reduced the availability of food for geese.

In 1997, five surveys were conducted during 8-22 September. As in fall 1996, water levels were high throughout the survey period and extended almost into the willows along the northern and

northeastern sides of Mills Lake. The sedge stands to the east of Mills Lake were also still covered with 1 m of water. Apparently as a consequence, Snow Geese were never observed in any appreciable numbers at Mills Lake in fall 1997.

4.3 Dark Geese

4.3.1 Spring migration

In 1994, Dark Geese were first observed at Mills Lake on 3 May when 4673 were already present (Table 1). The numbers of Dark Geese steadily declined afterwards when only 210 were observed on 14 May. Dark Geese were distributed in flocks of varying size in the sedge wetlands around the eastern and northeastern periphery of Mills Lake.

In 1995, as in 1994, Dark Geese appeared at Mills Lake in very early May. Counts of Dark Geese increased until 9 May (2,951) followed by a gradual decline until 21 May. As in 1994, Dark Geese were distributed around the eastern periphery of Mills Lake. The low flood level in 1995 meant that more of the extensive sedge wetlands around Mills Lake were available to geese in 1995 than in 1994. Similar to Snow Geese, Dark Geese may have been holding over longer and building-up in greater numbers than in 1994.

In 1996, spring Dark Goose counts were very low compared to the spring counts during the previous two years. As with Snow Geese, the extremely high water levels at Mills Lake resulted in the dense sedge stands and beds of aquatic plants that normally provide abundant food being unavailable. The late spring also resulted in a concentrated migration of Dark Geese that passed through the area quickly. Only 52 Dark Geese were observed at Mills Lake 14 May and numbers declined after that.

As in 1996, the extremely high water levels in 1997 resulted in Mills Lake once again offering virtually no feeding habitat for migrating geese. Only 481 Dark Geese were observed on 10 May and only 6 on 14 May.

4.3.2 Fall migration

In 1994, Dark Geese were first observed on 25 August (1,006). Numbers increased through to 13 September when 10,722 were observed then decreased to 708 on 4 October (Table 1). Like Snow Geese, large flocks of Dark Geese were observed in the sedge wetlands around the east and northeast sides of Mills Lake.

In 1995, even though water levels were similar to 1995 with a large amount of exposed sedge wetlands, numbers of dark geese were considerably lower (Table 1). Maximum numbers or Dark Geese occurred on 5 September (3,964) and decreased through until mid-October. It is not obvious why fewer Dark Geese staged at Mills Lake in 1995 in contrast to 1994, despite the apparent good feeding conditions there in both years.

In 1996 and 1997, years when standing water covered much of the sedge wetlands, the numbers of staging Dark Geese differed markedly. In 1996, only a few hundred Dark Geese were observed during surveys in mid-September and few geese were observed after 20 September (Table 1). In 1997, however, several thousand were noted during each of the first three surveys in early to mid-September, then numbers declined sharply after that. Even though much of the sedge wetlands on the northeastern side of Mills Lake were partially flooded Dark Geese, unlike Snow Geese, were observed using them.

4.4 Tundra Swans

4.4.1 Spring migration

In 1994, the first Tundra Swans appeared at Mills Lake on 3 May. Maximum numbers of Tundra Swans (1,535) were observed on 6 May with numbers declining markedly thereafter (Table 1). Tundra Swans were distributed across much of the open water of Mills Lake (Figure 2).

In 1995, Tundra Swans were first observed at Mills Lake on 1 May and increased in numbers until 12 May (5,775) and then declined gradually until to 21 May. The counts of Tundra Swans in 1995 were twice that of 1994. Similarly to 1994, Tundra Swans were observed across the entire expanse of Mills Lake in 1995 with another concentration along the south side of the Mackenzie River. The shallow waters meant that the extensive submergent vegetation in those areas was readily accessible.

In 1996, Tundra Swans were far fewer in number in 1996 with only 693 present on Mills Lake on 21 May compared to daily survey counts of 1,000-5,000 during the same period in 1994 and 1995. The extremely high water levels resulted in the submergent vegetation that normally provided abundant food for swans being largely unavailable.

In 1997, as in 1996, the extremely high water levels resulted in Mills Lake offering virtually no feeding habitat for migrating swans.

4.4.2 Fall migration

In 1994, Tundra Swans did not concentrate at Mills Lake until the third week of September (Table 1). Numbers increased markedly into early October when 10,070 were observed on 4 October. As in spring, Tundra swans were distributed across the remaining open water in the Mills Lake basin. In addition, large numbers of swans were observed along the south side of the Mackenzie River directly

south of Mills Lake where it was shallow enough that they could feed on beds of submergent vegetation (Figure 2).

Similar to 1994, Tundra Swans did not begin concentrating at Mills Lake until mid-September in 1995 (Table 1). They peaked on 25 September (6,754), although they were observed until 16 October (2,709) when the first new ice pans were observed on the Mackenzie River.

In both 1996 and 1997, Tundra Swans almost totally avoided Mills Lake and the adjacent Mackenzie River (Table 1). This was most likely due to the high water levels which resulted in beds of submergent vegetation being too deep for accessibility by swans.

4.5 Shorebirds

4.5.1 Spring migration

In 1996, the survey area constituted approximately 100 km of shoreline and flooded sedge stands. Total shorebird counts ranged from 260 to 630 during the three surveys. Considering the length of survey area, these represent very low counts compared to counts at large shorebird staging areas farther south (e.g., Alberta, Saskatchewan; G. Beyersbergen, pers. comm.). Unfortunately, there is little comparable information from wetlands in the Western Arctic and Sub-arctic. It is quite likely, however, that the high water levels that persisted at Mills Lake into at least June resulted in the area being far less attractive to staging shorebirds. In other years there is more exposed shoreline and mudflats by late May and therefore greater availability of food for staging shorebirds.

In 1997, Mills Lake was still in flood condition on 6 June. There was standing water to the edge of the willows along the northern and northeastern sides of the lake and the sedge stands on the eastern and northern sides were still under 1 m of water. Total shorebird counts ranged from 1,565 on 29 May to 25 on 6 June. As in 1996, these are low counts compared to those obtained at shorebird

staging areas elsewhere in the northern North America and at southern staging areas. The extremely high water levels at Mills Lake in spring 1997 probably greatly reduced the availability of shorebird habitat compared to a year with lower water levels when there would be considerably more exposed mudflats and rocky shoreline.

4.5.2 Fall migration

Only two shorebird surveys were flown during fall. The same 100 km of shoreline as in spring was covered. On 19 August there was the same high water level as last observed in early June. The water edge extended back to within 0.5 km of the willows around the northern edge of Mills Lake and much of the dense sedge stands around the east side remained flooded under as much as 1 m of water. No shorebirds were observed during this survey. On 23 August, only small numbers of small and medium size shorebirds were observed. Since the main shorebird migration has typically passed through the Mills Lake/Great Slave area by late August and considering the low counts of the first two surveys, further survey flights were suspended. It is quite probable, that the persistent high water levels resulted in low availability of suitable feeding habitat for staging shorebirds in fall 1996. No fall shorebird surveys were flown in 1997.

5.0 KEY HABITAT SITE

In both 1994 and 1995 (lowest water years), the average daily counts of Snow Geese suggest that considerably greater numbers were staging at Mills Lake compared to fall 1972 and spring 1973 (Salter 1974; Salter et al., 1974). This apparent increase likely reflects the large increase in the Western Arctic Population of Lesser Snow Geese, estimated in 1995 at nearly 500,000 nesting birds (Kerbes et al., 1999). CWS has recognized Mills Lake as a key habitat site (Alexander et al., 1991) meaning that at some point in the year 1% or more of the national population of a migratory bird species of subspecies occurs there. Several of the higher daily counts recorded in 1994 and 1995, both spring and fall, represented 3-10% of the Western Arctic Population of Lesser Snow Geese. Mills Lake is also used by the Wrangel Island population of Lesser Snow Geese, but to an unknown

extent (Kerbes et al., 1999). In spring 1995, a Snow Goose radio collared by the USFWS the previous year on Wrangel Island (J. Takekawa, pers. comm.) was located at Mills Lake. The Wrangel Island population varied markedly between 1975-95 and has not shown the rapid increase seen in the Western Arctic population (Kerbes et al., 1999). Maintenance of the Wrangel Island population is an ongoing management concern and Mills Lake may represent important habitat in their spring migration which follows an inland route through Alberta and Saskatchewan and into the NWT, in contrast to the Pacific coast route used in the fall (Armstrong et al., 1999).

In 1994-95 the average daily counts of Dark Geese suggest that the numbers of staging geese did not differ markedly from the fall 1972 and spring 1973 surveys. If it is assumed that the large majority of Dark Geese counted were Greater White-fronted Geese then several of the daily counts in 1994-95 represented 4-14% of the Western Arctic Population (both Canadian and Alaskan birds) of 56,000 nesting birds (Hines and Wiebe, 2003) and as much as 1.8% of the total Mid-continent Population of 598,000 nesting birds, assuming that the large majority of these birds were Canadian and not Alaskan breeders. Alexander et. al. (1999) estimated that a minimum of 8% of the Western Arctic Population staged at Mills Lake in 1972-73.

The daily counts of Tundra Swans in 1994-95 were 3-4 times higher than observed in fall 1972 and spring 1973 (Salter 1974) and likely reflected the increasing size of the Eastern Population of Tundra Swans. Several of the daily counts in both 1994 and 1995 comprised 2-12% of the total Eastern Population of Tundra Swans which have numbered 90-100,000 in recent years (Canadian Wildlife Service, 2002). Mills Lake appears to be an important migration staging site for Tundra Swans in the Mackenzie Valley when water levels allow them access to submergent vegetation.

The results of spring and fall aerial surveys indicate that Mills Lake remains a very important staging wetland during the spring and fall migration of waterfowl along the Mackenzie Valley. Mills Lake can be considered a "key habitat site" not only because of its importance over the long-term to migrating geese and swans but because of the broader biodiversity it represents. Recently, this has been formally recognized by local communities and government and steps are underway to ensure this large wetland receives legal protection. As part of the designation process, the breeding bird community at Mills Lake will be assessed. The results of that study coupled with the information from the present and earlier migration surveys will provide managers with a fuller picture of the avian community using Mills Lake.

6.0 LITERATURE CITED

Alexander, S.A., R.S. Ferguson and K.J. McCormick. 1991. Key migratory bird terrestrial habitat sites in the Northwest Territories. Occasional Paper No. 71. Canadian Wildlife Service. Ottawa.

Armstrong, W.T., K.M. Meeres, R.H. Kerbes, W.S. Boyd, J.G. Silveira, J.P.Taylor and B.Turner. 1999. Routes and timing of migration of Lesser Snow Geese from the Western Canadian Arctic and Wrangel Island, Russia, 1987-1992. In: R.H.Kerbes, K.M.Meeres and J.E.Hines (eds.). Distribution, survival, and numbers of Lesser Snow Geese of the Western Canadian Arctic and Wrangel Island, Russia. Occasional Paper No. 98. Canadian Wildlife Service. Ottawa.

Ecological Stratification Working Group. 1995. A national ecological framework for Canada. Agriculture Canada and Environment Canada. Ottawa.

Population status of migratory game birds in Canada. 2002. Canadian Wildlife Service Migratory Birds Regulatory Report No. 7. Canadian Wildlife Service, Ottawa.

Fuller. W.A. 1952. Proposed bird sanctuaries at Mills Lake and Wrigley Harbour, NWT, September 1953. Canadian Wildife Service. Fort Smith, NWT.

Hines, J.E. and M.O. Wiebe. 2003. Surveys of geese and swans in the Inuvialuit Settlement Region, Western Canadian Arctic, 1989-2001. Occasional Paper. (in press). Canadian Wildlife Service, Ottawa.

Beckel, D. 1975. International Biological Program Ecological Sites in Subarctic Canada. International Biological Program, Panel 10, Summary Report. University of Lethbridge Production Service.

Kerbes. R.H., V.V.Baranyuk and J.H. Hines. 1999. Estimated size of the Western Canadian Arctic and Wrangel Island Lesser Snow Goose populations on their breeding and wintering grounds. In: R.H. Kerbes, K.M. Meeres and J.E. Hines (eds.) Distribution, survival, and numbers of Lesser Snow Geese of the Western Canadian Arctic and Wrangel Island, Russia. Occasional Paper No. 98. Canadian Wildlife Service, Ottawa.

Norton-Griffith, M. 1978. Counting animals. Serengeti Ecological Monitoring Program, Handbook No. 1. Nairobi, Kenya.

Salter. R. 1974. Autumn migration of birds through the central and upper Mackenzie Valley region, 1972. In: W.W.H. Gunn and J.A. Livingston (eds.) Arctic Gas Biological Report Series. Vol 13. L.G.L. Limited.

Salter, R., W.J. Richardson and C. Holdsworth. 1974. Spring migration of birds through the Mackenzie Valley, NWT, April-May 1973. In: W.W.H. Gunn, W.J.Richardson, R.E. Schweinsburg and T.D. Wright (eds.) Arctic Gas Biological Report Series. Vol. 28. L.G.L. Limited.

Soper. J.D. 1952. Proposed bird sanctuary at Mills Lake, upper Mackenzie River, NWT. Canadian Wildlife Service, Edmonton.

Trottier, G.C. and J.B. Kemper. 1974. A reconnaissance vegetation survey, Mills Lake, Northwest Territories. Canadian Wildlife Service (Unpubl. Report). Edmonton.

7.0 PERSONAL COMMUNICATIONS

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Table 1. Daily counts of Lesser Snow Geese, Dark Geese, Tundra Swans and Sandhill Cranes at Mills Lake during spring and fall migration, 1994-1997.

Year	Date	Snow Geese	Dark Geese	Tundra Swans	Sandhill Cranes
1994	27-Apr				
(Spring)	03-May	11710	4673	365	
	06-May	26644	2981	1535	
	10-May	2150	1307	957	
	14-May	1270	218	228	
	17-May	675	210	80	
1994	25-Aug	0	1006	2	
(Fall)	29-Aug	0	2305	0	
	04-Sep	20	3787	0	
	10-Sep	240	7650	7	
	13-Sep	1100	10722	12	15
	16-Sep	6322	10614	95	
	22-Sep	4706	2306	2649	
	26-Sep	7400	3209	2445	
	30-Sep	2080	1325	6980	
	04-Oct	2830	708	10070	
1995	01-May	0	734	18	36
(Spring)	04-May	375	773	62	
	07-May	17600	1391	1366	
	09-May	16244	2951	5249	
	12-May	47450	2369	5775	
	14-May	10035	321	5072	
	17-May	6422	1529	3226	
	21-May	200	2	1185	
1995	05-Sep	0	3964	73	
(Fall)	15-Sep	40	1213	4193	
	19-Sep	30	91	5035	
	25-Sep	2030	110	6754	
	10-Oct	200	435	3101	
	16-Oct	250	20	2709	
1996	14-May	0	52	331	
(Spring)	21-May	0	15	693	2
	24-May	0	0	0	
1996	16-Sep	580	523	0	
(Fall)	20-Sep	215	204	249	
	25-Sep	115	10	0	
	13-Oct	0	0	3	
1997	10-May	250	481	39	
(Spring)	14-May	25	6	2	
1997	08-Sep	0	5409	0	
(Fall)	11-Sep	0	3041	0	
	15-Sep	30	4055	0	
	18-Sep	0	924	0	
	22-Sep	0	0	0	

Table 2. Average daily counts of Lesser Snow Geese, Dark Geese and Tundra Swans seen during aerial surveys at Mills Lake in the 1970s and 1990s.

Survey year	Snow Geese		Dark Geese		Tundra Swans	
	Spring	Fall	Spring	Fall	Spring	Fall
1972	----	1709	----	7540	----	850
1973	1690	----	361	----	146	----
1994	6148	3087	1878	4363	633	3180
1995	14047	510	1259	972	2744	3644
1996[1]	0	303	34	246	512	84
1997[2]	138	30	244	3357	21	0

[1]due to high water levels, only 2 surveys were flown in spring and 4 in fall
[2]due to high water levels, only 2 surveys were flown in spring and 5 in fall

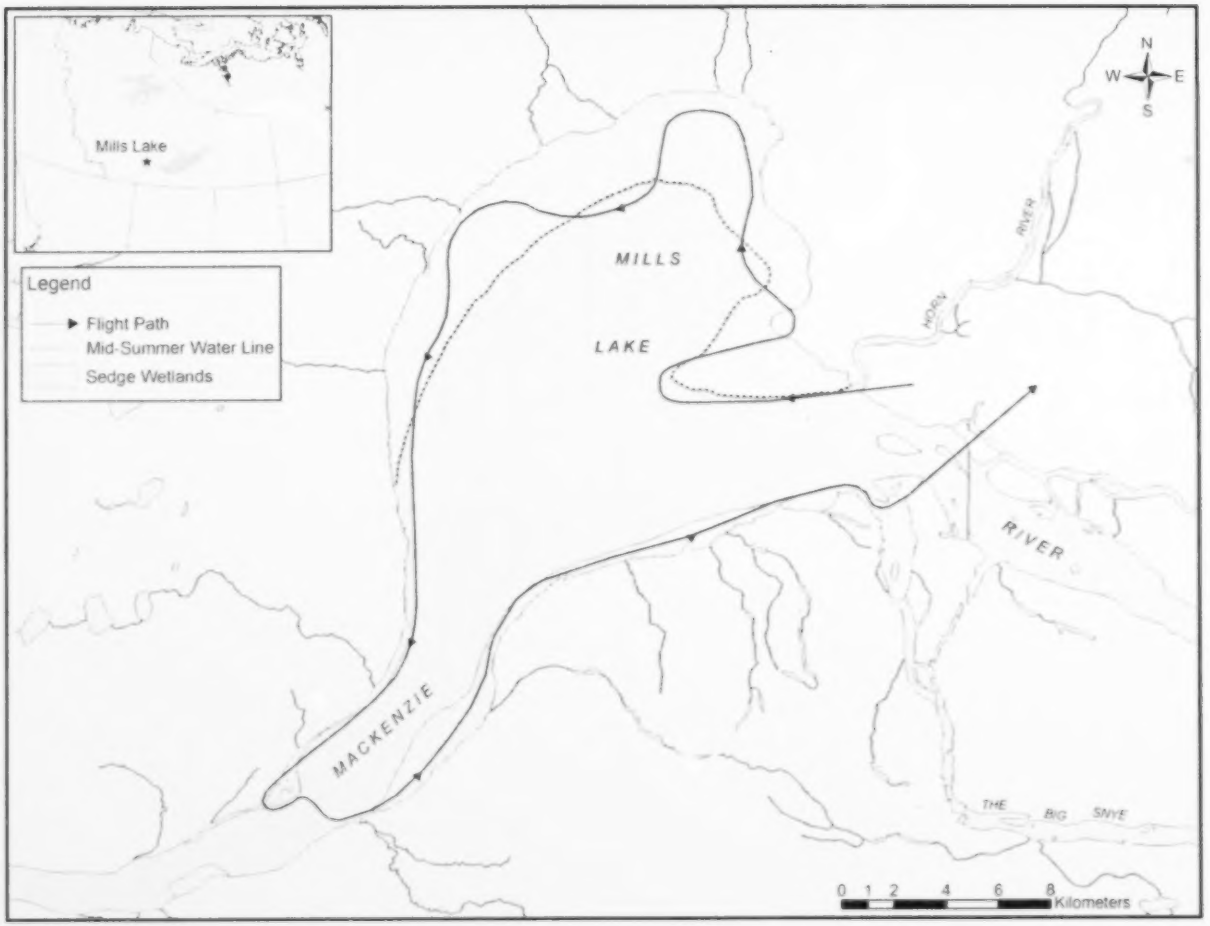

Figure 1. The aerial survey route generally followed during spring and fall migration surveys at Mills Lake, 1994-1997

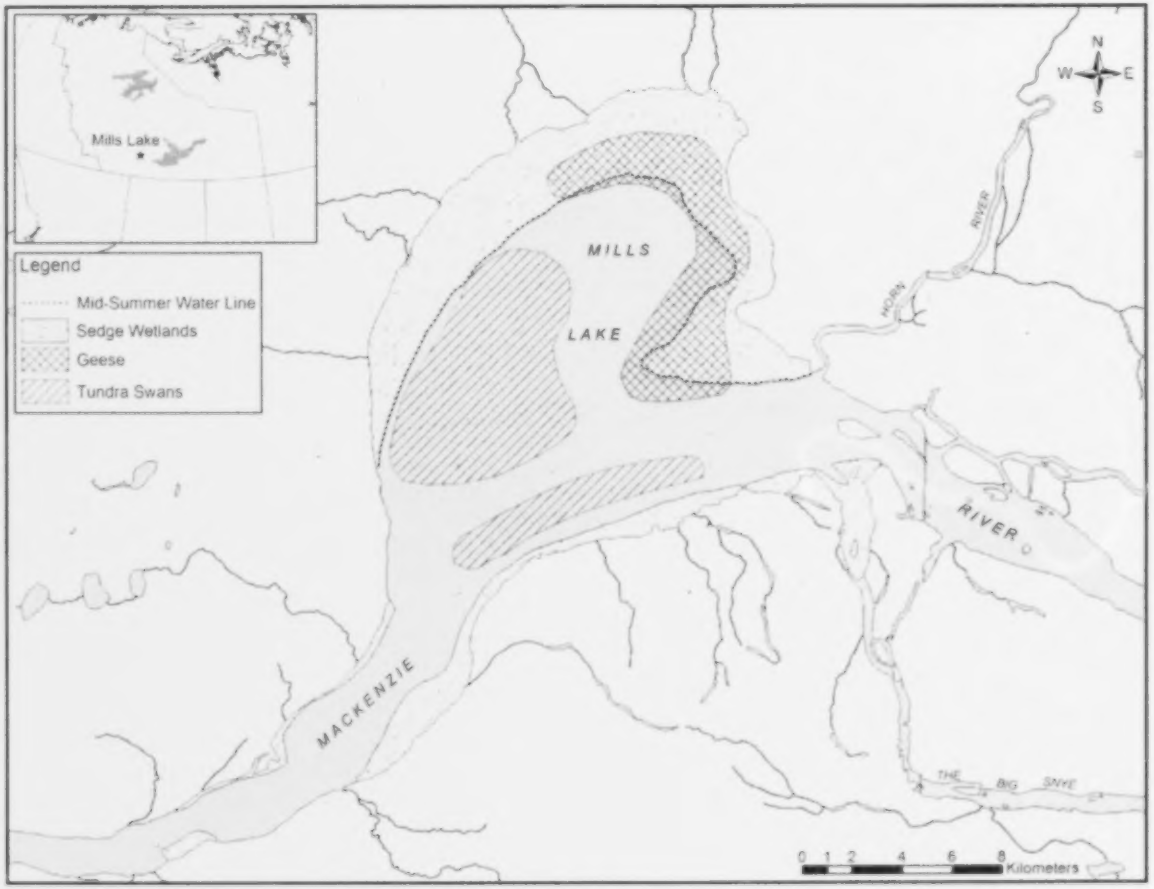

Figure 2. Areas where geese (Lesser Snow Geese, Dark Geese) and Tundra Swans were concentrated at Mills Lake, 1994-1997.